

Color, Pain, and the Agent-Centered Model of Perception

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Abstract Pain and color perception are difficult to accommodate within the standard model of perception which presupposes that perception is strictly in the business of informing us about the mind-independent states of the extra-mental world. By contrast, both can be easily accommodated within an alternative, *agent-centered* model of perception which holds that the overarching function of perception is to guide successful action and that perceptions need not align with mind-independent reality to play this role. I propose that the explanatory flexibility of the agent-centered model makes it the preferable model of perception. I first give an overview of the standard model and its treatment of color perception and pain and then highlight two problems the model faces: metamerism and intrapersonal variation in color perception. I use these problems to motivate the agent-centered model and show how the model can also straightforwardly accommodate the complexities of pain. After addressing three worries about the agent-centered model, I conclude that we have good reasons for adopting it as a general framework for philosophical work on perception.

1. Introduction

Gary Hatfield's careful integration of historical and contemporary insights from multiple disciplines, his attentiveness to the nuances of perceptual phenomenology, and his willingness to critically interrogate entrenched ideas about what and how we see have led to some of the most exciting developments in the work on perception over the last half-century. These contributions continue to inspire those who suspect that much of contemporary philosophy of perception has become stuck in rigid grooves. In this work, I outline one way to move beyond those grooves.

More specifically, I challenge the prevailing model of perception which holds that perception is strictly in the business of informing us about the mind-independent states of the extra-mental world. In doing so, I focus on color and pain perception because both are notoriously difficult to accommodate within this standard model. By contrast, both are easily accommodated within a broader agent-centered model, which maintains that the overarching function of perception is to guide successful action in an environment, and that *perceptions need not align with mind-independent reality*. The model therefore leaves open the question of how perceptual systems fulfill their action-guiding role and prescribes that answering this question proceed in an empirically guided manner. I propose that this explanatory flexibility makes the agent-centered model a more promising framework for philosophical work on perception.

Section 2 outlines the standard model and its treatment of color and pain perception. Section 3 highlights two problems for the standard model: metamerism and intrapersonal variation in color perception. Section 4 uses these problems to motivate the agent-centered model, while section 5 demonstrates how this model can also straightforwardly accommodate pain perception. Sections 6,7 and 8 address the following worries: that pain experience is not genuinely perceptual, that the

agent-centered model is trivial, and that the notion of ineliminably subjective (mind-dependent) aspects of perception is untenable. Section 9 concludes that we have good reasons to adopt the agent-centered model in place of the standard model.

2. The standard model of perception

The standard model of perception presupposes that the function of perception is strictly to inform us about *mind-independent* properties or states of the world. This assumption serves as a guiding framework for explaining perception and perceptual experience and is widely endorsed by contemporary philosophers. Standard *representationalism* claims that perceptual states represent mind-independent properties/states, and that the phenomenal character of perceptual experiences is fully explained by such representational contents (e.g., Dretske 1995; Tye 1995, 2000; Lycan 1996, 2014; Byrne 2001; Kulvicki 2007). Hatfield (2016) calls this “content physicalism.” Standard *relationalism* maintains that veridical perception is fundamentally relational, i.e., constituted in terms of a relation of direct sensory awareness to objects and their sensible qualities (e.g., Campbell 2002; Fish 2009; Brewer 2011). Many call this “naïve realism.” For simplicity, I will primarily focus on representationalism, while incorporating relationalist insights where appropriate.

2.1. Color perception on the standard model

I will refer to any view of color perception that falls within the standard model as a *standard account* of color perception. On standard representationalist accounts, the representata of color perceptual states are physical properties of the external world. On standard relationalist accounts, color experience directly acquaints us with mind-independent color properties of external objects and scenes.¹ A wide variety of theories fall within these broad categories, but as a representative example, I will briefly outline Michael Tye’s representationalist view.

Tye proposes that we think of visual percepts as “interpreted, symbol-filled patterns of cells” in a visual array in the brain, where the symbols represent the presence of a tiny patch of surface, its orientation, texture, and “determinate shade of color” (1995, 122). A key motivation for standard representationalist accounts of visual perception is the (purported) observation that visual states correlate well with the physical properties/states they supposedly represent. In the case of color perception, the relevant physical property is often taken to be the spectral reflectance of the object surface, i.e., the way in which the surface reflects and absorbs light as a function of wavelength (e.g., Byrne and Hilbert 2003). And, indeed, color experiences generally correlate *better* with such reflectances than they do with other relevant physical properties, such as the spectral characteristics of the incoming light from an object (Shevell and Kingdom 2008, 149). For a

¹ Note the difference between standard relationalism and relationalism *about color* (and/or other perceptual qualities). Whereas a standard relationalist takes the act of perceiving itself to be relational, a color relationalist takes color to be constituted by a relation between a perceiver and an object, and perhaps the perceptual circumstances. As such, color relationalism can be seen as a third option in addition to pure color objectivism (colors are mind-independent properties of ordinary objects) and color subjectivism (colors are purely mental or psychological properties) in color metaphysics (see Hatfield 2003). Because standard relationalism, as defined here, opts for a purely objectivist metaphysics of perceptual qualities, it is not compatible with relationalism about color.

philosopher already committed to the idea that color experience represents *some* physical property, surface spectral reflectance (SSR) therefore seems like a good candidate.

Recall that, on the standard representationalist view, the phenomenal character of perceptual experience is fully explained by its representational content. The idea that color experiences represent SSRs therefore suggests straightforward success conditions for conscious color perception: a color experience is accurate (or veridical) when it represents the relevant SSRs correctly. And, conversely, any experience that deviates from this standard is inaccurate (or non-veridical)—a color illusion or hallucination. Many representationalists accept that each bit of uniformly colored surface has one *true* fine-grained color (at least relative to a perceiver type) that color perception aims to track, even if we might not know what the true fine-grained color is (e.g., Byrne and Hilbert 2003, 17; but see Tye 2006a).

A standard account of color perception need not identify color with a property like SSR, however. It can instead posit primitive colors—mind-independent, qualitative, *sui generis* properties that perhaps supervene on SSRs but do not reduce to them. Those who adopt this view tend to be standard relationalists who think that perceptual experience directly acquaints us with such properties and that color experience inherits its qualitative character from them (e.g., Campbell 1993). That said, the notion of primitive colors is mysterious and fits uneasily into a scientific description of the world, which makes primitivism an unattractive option to many naturalistically inclined philosophers. This is not to say that color primitivism cannot itself be empirically informed (see Allen 2016; Gert 2017), only that standard accounts of color perception tend to favor reductive treatments of color.

2.2. Pain perception on the standard model

Standard representationalist accounts of pain typically employ the same theoretical tools as such accounts of color do. For example, Tye’s view of pain perception parallels his view of visual perception: pain percepts are patterns of interpreted, symbol-filled cells in topographically structured three-dimensional arrays, where the symbols “may be conceived of as representing... that there is tissue damage at the body region to which the cell is dedicated” (1995, 121; see also 2006b). The view that pain percepts represent actual or potential tissue damage, or some disturbed physical condition of body parts, is common among standard representationalists (e.g., Dretske 1995; Bain 2003), even if it is often left vague how to delineate such conditions.

It is also commonly assumed that pain experiences represent certain global features of the relevant bodily disturbances, including their duration (e.g., brief), location (e.g., lower back), severity (e.g., mild), and quality (e.g., stabbing). These correspond to phenomenological aspects of pain experience. According to Tye, the global features are represented via “further routines that mechanically work over the array and extract at least *some* of the relevant content from its contents” (1995, 121-122). This suggests that pain perception, like color perception, has clear success conditions: pain experiences are accurate when they correctly represent bodily disturbances and their mind-independent global features. For example, “a twinge of pain” felt in a specific body part represents correctly when it tracks a “brief, mild disturbance” in that body part (1995, 113).

It is important to note, however, that this view does not entail that a person whose pain experience misrepresents their bodily condition does not have genuine pain. Tye (2000, 59) and many other proponents of standard accounts of pain grant that the concept of pain (or at least *one* concept of pain) refers to the experience itself. In this sense, they can hold that to feel pain is to have pain, even when the experience misrepresents (see Byrne 2001; Liu 2021; for critical discussion, see Aydede 2019a).

Finally, just as proponents of standard accounts can say that color experience directly acquaints us with primitive color properties, they could also say that pain experience directly acquaints us with mind-independent qualitative pain properties that perhaps supervene on tissue damage but do not reduce to it. That said, such views are hard to come by, perhaps because the notion of a mind-independent qualitative pain is intuitively strange. It is much more common for philosophers to hold that pain experience is not perceptual at all (I will return to this point in section 6).

3. Why color perception is a problem for the standard model

I have outlined Tye's view of perception as an example of an account that falls within the standard model. The view is attractive in its simplicity and scope; Tye proposes that *all* bodily sensations and perceptual experiences have their contents encoded in arrays, and that the cells in these arrays, when filled, represent physical states and properties (1995, 122). The representational content further explains the phenomenal character of experience. That said, Tye's view, and the standard model of perception in general, falls short when it comes to accommodating and explaining perceptual phenomena. Recall that a key motivation for the standard model is the idea that perceptual states correlate well with the relevant mind-independent properties or states. If we focus on color perception, we find that this correlation is rather weak.

3.1. *The problem of metamers*

A simple, one-to-one correspondence between SSRs and color experiences would support the idea that color visual systems are in the business of tracking and representing SSRs. But we find no such correspondence. The first problem we encounter is the phenomenon of metamerism: the existence of distinct SSRs that yield identical color experiences in some perceivers in specific lighting conditions. For example, two paint samples might appear the exact same shade of blue to you in daylight but look very different in evening sun: perhaps one still looks blue while the other now looks slightly purplish. This would mean that the samples are metameric matches under daylight.

The fact that (indefinitely many) distinct SSRs can result in the same color experience in a single perceiver leads to two problems. First, as Hardin notes, "there is no physical justification for putting [all the different metameric surface reflectances] into the same color class" (1993, 64). Second, as Hatfield (1992) points out, the color visual system's inability to distinguish between metamers undermines the notion that it functions as an SSR detector.²

² Color primitivism might appear to offer a straightforward way to accommodate metamerism within the standard model. Primitivism identifies colors with *sui generis* properties typically understood to

Some standard representationalists have responded that even if the SSRs that make up our (fine-grained, determinate) color classes are “quite uninteresting from the point of view of physics,” the color classes themselves are not subjective (Byrne and Hilbert 2003, 11; see also Tye 2000). The idea here appears to be that the phenomenon of metamerism merely tells us about *how* our visual systems represent SSRs without undermining the thesis that they do. More specifically, it suggests that our visual systems track *sets* of SSRs, which are considered as respectable (albeit disjunctive) *physical* properties. But the idea of perceptual equivalence classes that have little basis in physical reality still sits uneasily with the notion of mind-independent color, and there is debate about whether this response to the problem of metamerism succeeds. For example, Hatfield argues that because the sets of SSRs can only be defined in relation to the responses of color perceivers, they are *mind-dependent* (2007, 142).

But even if metamerism could be accommodated within standard accounts of color perception, these accounts face a further challenge: to explain successful color perception in terms of tracking mind-independent properties, without positing widespread error, the accounts need evidence of a *stable* correlation between color experiences and the properties they supposedly track. But no such correlation is to be found. Even in the case of a single perceiver, color experiences can vary by a surprisingly large degree.

3.2 The problem of intrapersonal variation

While metamerism tells us that there is no straightforward mapping from color experiences to SSRs, intrapersonal variation shows that the mapping from SSRs to color experiences is equally complex; the *same* SSR can yield different kinds of color experiences in the same perceiver in different perceptual conditions. Despite some philosophers’ fondness for the notion of *standard* or *optimal* conditions in which the true fine-grained colors of surfaces can be accurately or veridically perceived, the extent to which our color experiences vary with situational factors undermines the credibility of this notion (e.g., Hardin 1993; Cohen 2009). The color appearance of a target does not just depend on the target’s SSR but also varies—sometimes dramatically—with factors such as lighting conditions (e.g., Arend et al. 1991; Shevell and Kingdom 2008), viewing angles and distances, and spatiochromatic contexts (e.g., Ratnasingam and Anderson 2017; Klauke and Wachtler 2015). As a result, there is no strong correlation between physical surface properties and color experiences—nor, for that matter, between primitive properties that supervene on those physical properties and color experiences.

Some more complex standard accounts of color perception seek to accommodate this variation by appealing to situation-dependent properties that we perceive (or are presented with) either in addition to, or in lieu of, intrinsic colors. Such properties are taken to be relational but *mind-independent*, and explanatorily powerful. For example, Genone argues that we perceive mind-independent *appearance properties* “that objects possess in virtue of their intrinsic properties and various environmental conditions such as illumination of the medium of light transmission” and that the perception of these properties accounts for intrapersonal variation in color perception

supervene on SSRs. It avoids the problem of metamerism since the same primitive color can supervene on multiple distinct SSRs. However, as noted, the theoretical costs of primitivism are high.

(2014, 357).³ On Genone’s view, when a ripe tomato appears orange in (presumably narrow-band) yellow lighting, we are presented with an appearance property that can be analyzed in terms of the intrinsic color of the tomato and the spectral properties of the incident light. A fuller explanation might go as follows: the surface of a ripe tomato is disposed to reflect primarily long-wavelength (“red”) light and therefore appears red under normal, broad-spectrum illumination to most human perceivers. A narrow-band yellow light emits only a limited range of medium-wavelength light, and an object illuminated solely by such a light can reflect only those wavelengths. The tomato—also disposed to reflect *some* light in the medium-wavelength range, particularly the longer wavelengths within it—may then appear orange. And so, the orange appearance can be explained in terms of the spectral properties of the light reflected from the tomato’s surface in these specific lighting conditions.

While Genone’s proposal seems initially plausible in the case of the orange-appearing tomato, many other forms of intrapersonal variation resist explanation in terms of intrinsic properties and environmental conditions alone.⁴ Consider the phenomenon of simultaneous color contrast, where the perceived color of a target shifts away from the perceived color of its surroundings. Many familiar demonstrations show that a target’s appearance can change drastically depending on background color; for example, a surface that looks orange on an achromatic grey background might look distinctly yellow against red, and distinctly red against yellow. In such demonstrations, the target’s SSR remains the same, as does the light it reflects into the eye.

While the change in the target’s color appearance correlates with the change in its surround, the change in the surround alone does not explain the change in appearance; a *genuine* explanation of this phenomenon must appeal to how our visual system processes spectral information. In other words, the effect can only be explained by factors internal to the perceiver, such as the functioning of the double-opponent cells in the visual cortex (see, *e.g.*, Shapley et al. 2014, 572). And so, if we are presented with appearance properties when observing simultaneous contrast cases, those appearance properties are only tenuously described as being mind-independent.⁵ Consequently,

³ Genone is a standard relationalist. For an account that combines standard representationalism with standard relationalism and posits mind-independent but situation-dependent appearances, see Schellenberg (2008).

⁴ In fact, even completely *ordinary* color appearances seem to resist Genone’s explanation. As already mentioned, color experiences correlate better (albeit imperfectly) with SSRs than they do with the spectral properties of the light entering our eyes from an object. This is to say that our color experiences *tend toward* constancy across lighting conditions, even if such constancy is not strong enough to motivate the view that color experiences track SSRs. Although Genone does not specify all the relevant environmental conditions, his tomato example suggests that, when it comes to color experience, lighting conditions are what he has in mind. On this view, it seems that color appearances ought to correspond to spectral input to the eye, since such input is the mind-independent property that combines SSRs and situation-dependent lighting conditions. But color appearances normally lie somewhere between SSRs and such input (Shevell and Kingdom 2008), and there does not appear to be a mind-independent property they straightforwardly correspond to. Explanations of ordinary color appearances in terms of intrinsic properties and environmental conditions therefore do not do better, in this respect, than explanations that appeal to intrinsic color alone.

⁵ Genone suggests that only the perception of appearances (and not the appearances themselves) depends on factors internal to the perceiver: “...we should distinguish between an object having a particular

Genone's view, along with other appearance versions of standard accounts, face significant challenges in accounting for perfectly ordinary color perceptual phenomena.

Of course, a proponent of a standard account can always conclude that the simultaneous contrast effect and other sources of intrapersonal variation give rise to *illusory* chromatic experiences. But given how common these effects are in everyday vision, this would imply that a large proportion of perfectly ordinary color perception is illusory. Such a conclusion would be unwelcome in itself but it would also undermine the intuitive appeal of the standard model: if color vision routinely fails to successfully (re)present the relevant mind-independent properties, what basis remains to think that its function is to inform about such properties?

4 The alternative: the agent-centered model

The standard model states that perception functions to inform perceivers about (aspects of) mind-independent reality as it is. This is compatible with the idea that perception ultimately serves successful action, as long as perception does so by conveying information about the mind-independent states of our internal and external environments. An alternative to this model is the idea that the overarching function of perception is simply to be a guide to successful action and that perceptions need not align with mind-independent reality to play this role. The alternative therefore leaves open the question of how perceptual systems fulfill their action-guiding role and prescribes that answering this question proceed in an empirically guided manner with attention to animal-environment interactions. I label this alternative framework the *agent-centered model of perception*.

4.1. Views compatible with the agent-centered model

The agent-centered model, like the standard model, is exemplified by a range of philosophical views. I offer two illustrative examples. First, consistent with the agent-centered approach, Kathleen Akins (1996) proposes that we start by asking what sensory systems are doing, with a focus on what matters to the perceiver. Drawing primarily on neurobiology, she argues that many

appearance, and a subject perceiving its appearance on a given occasion. The latter requires that the perceiver possesses the relevant sensory physiology, occupies an appropriate vantage point, and actually attends to the appearance in question" (2014, 358). But we still want an explanation of why simultaneous color contrast effects occur and only factors internal to the perceiver can provide such an explanation. The same is true of many other perceptual phenomena. Consider, for example, the perceptually enhanced edges between bands of differing shades of grey. Traditionally, such "Mach bands" have been explained by lateral inhibition, i.e., the capacity of an excited neuron to inhibit the activity of its neighboring neurons (Mach 1865/1965). More recently, a variety of competing physiological explanations have been proposed, including response normalization, i.e., the normalization of responses of neurons with respect to the local average activity of other neurons (Kingdom 2014). Genone could argue that lateral inhibition or response normalization is simply part of the "relevant sensory physiology" required for the perception of Mach bands, which are themselves mind-independent appearances out in the world. But this would sound implausible and mysterious. Why populate our ontology with a seemingly infinite number of free-floating mind-independent appearances, some of which we just *happen* to perceive, when we can explain the existence of the appearances that we *actually* have by a straightforward appeal to the specifics of our perceptual machinery?

types of sensory states are not adequately described as being aimed at veridically representing mind-independent properties. For example, in the case of peripheral thermoreception, the relevant sensory states (and the associated phenomenal experiences) help us avoid damage without tracking objective states of the skin.⁶ Second, Hatfield (2016, see also 2007, 2009), drawing on ecological, phenomenological and psychophysical considerations, offers an account of (visual) perception that emphasizes subjective aspects of perception. He proposes that perception serves action via “subjectively conditioned” (i.e., mind-dependent) appearances and that the representation of physical, mind-independent properties of the environment requires additional cognitive acts of categorization. Hatfield (2011, 2016) characterizes this view as a variant of *critical direct realism*, in the tradition of R. W. Sellars (1920), and focuses on spatial properties and color to make his case.

Akins and Hatfield are both committed to the idea that perception cannot be adequately explained without explicit reference to organism-specific goals and needs and without careful attention to empirical data. Rather than viewing the animal’s environment as containing aspects of physical reality to be passively detected by perceptual systems, they see it as populated with opportunities for action and interaction, with information often presented “narcissistically” or subjectively in a way that aligns with the perceiver’s needs, goals, and capacities. Many other philosophers, along with scholars from other disciplines, have also offered views that align with this outlook. For example, Hoffman (2009) proposes that perception constitutes “a species-specific user interface” that guides adaptive behavior in a niche, and that evolution tends to favor perceptions that are tuned to the relevant fitness functions, not to physical values (see also Matthen 2005; Koenderink 2014; Hoffman et al. 2015). Thompson, focusing specifically on color vision, writes that the “world outside the perceiver must be considered as an environment, rather than a neutral material universe, and the perceiver must be considered as an active exploring animal” (1995, 244). Chirimuuta, in a similar vein, notes that color vision “can be best understood as a means by which organisms make sense of the complexity of the natural environment” (2015, 15).⁷

While the agent-centered model naturally resonates with this emphasis on the embodied and embedded aspects of perception and is compatible with approaches that emphasize the subjectivity of perception, it does not dictate that perception *never* guides successful action in an environment by (re)presenting mind-independent properties of the environment. It merely challenges the *a priori* assumption that it always does. Questions about the ways in which different kinds of perceptual systems guide action are, after all, empirical.

⁶ Akins writes that “sensory systems exemplify (usually quite elegant) solutions to specific processing problems. Sometimes reliable correlations [to physical properties] are used...and sometimes they are not” (1996, 366). For Akins, what unifies all sensory systems is their role in guiding action: “each and every sensory system, no matter how sophisticated or simple, is tied to a set... of behavioral tasks. No matter what else the senses do, in the end, they must inform movement or action” (1996, 352).

⁷ It is important to distinguish this group of views from certain “action-oriented” accounts of perception which maintain that perception presents us with “perspectival” or “situation-dependent” properties of objects (e.g., Noë 2004; Schellenberg 2008). Though these views acknowledge the intimate connection between perception and action, they nevertheless uphold the idea that the properties of which we are aware in successful (veridical) perceptual experience are mind-independent. As such, they are cousins of Genone’s appearance view, discussed in section 3.2, and compatible with the standard model.

4.2. *The agent-centered model and color perception*

Metamerism and intrapersonal variation pose significant challenges to the idea that the function of color perception is to represent surface reflectances, or to (re)present any other kind of mind-independent properties. My goal now is to show that accounts of color perception that forgo this assumption can offer better explanations of color perceptual phenomena. I will refer to such accounts as *non-standard* accounts, since they are incompatible with the standard model.

How might we go about building an explanatorily robust account of human color perception? A natural starting point is the observation that successful action is closely tied to object perception; our interaction with our environment primarily involves engaging with the objects it contains. We can then ask *how* color vision might contribute to object perception, drawing insights from ecology, vision science, and the phenomenology of visual experience. Such inquiry suggests that human color vision makes important contributions to figure-ground segregation and scene segmentation: color vision helps parse visual scenes into distinct object components, and this kind of support is especially crucial in complex scenes with shadows and other kinds of light noise (see, e.g., Hatfield 1992, 2009; Akins 2001; Akins and Hahn 2014; Chirimuuta 2015). Simultaneous color contrast plausibly aids in this process by increasing the chromatic contrast between objects and their backgrounds. Consequently, the lack of a stable correlation between our color experiences and surface reflectances (or any mind-independent properties, relational or intrinsic) need not indicate a “failure” of the system, as the standard model implies, but can also indicate its success (Rosenqvist 2023a, 2023b; see also Chirimuuta 2015, 182-3).

Further inquiry suggests that color vision plausibly also serves many other visual and visual-cognitive tasks, such as object and property identification (for a helpful overview of the potential contributions of color vision, see Chirimuuta 2015, ch. 4). For example, the blueness of a ripe blueberry helps us recognize its “blueberry-ness,” and neither metamerism nor most types of intrapersonal variation prevent color vision from playing this role. As long as ripe blueberries appear within a certain chromatic range, their chromatic appearance can aid in identification (Hatfield 1992, 2003; see also Thompson 1995). Once we let go of the assumption that, in successful perception, the chromatic appearance of objects must be explained solely by the (re)presentation of mind-independent properties, we can begin to appreciate the many ways in which our color visual systems facilitate our interactions with our environments. The correctness of color experiences can then be directly tied to this sort of usefulness (Chirimuuta 2015, ch. 5; Rosenqvist 2023a).

The ability of non-standard accounts of color perception to explain a wide range of ordinary perceptual phenomena, and to preserve the intuitively appealing idea that most of our everyday color perception is successful, counts in their favor. Yet despite these advantages, and despite sustained criticism of standard accounts of color perception, the standard model remains the received view in philosophy of perception. One possible explanation is that philosophers have tended to overlook additional problem cases that challenge the model. Confronted with a single case, there might be a temptation to shoehorn it into the received view and bear the theoretical costs, which might include positing widespread misperception and accepting that color facts are

unknowable. But as cases accumulate, the argument against the model gains force. In the next section, I discuss another problem case for the standard model: pain.

5. The standard model, the agent-centered model, and pain

If the standard model struggles to accommodate color perception, it arguably faces an even greater challenge in accounting for pain phenomena. A brief foray into pain science reveals that the correlation between pain experiences and the features of disturbed or damaged states of body parts is even weaker than the correlation between color experiences and SSRs. Though we also find a more general dissociation between pain experiences and bodily disturbances (Wall 1979), I will focus here on the relationship between the felt intensity of pain and the severity of the underlying bodily disturbance.

When it comes to pain intensity, we find plenty of evidence of contextual modulation. First, temporal adaptation to repeated stimulation is well documented: the same noxious stimulus does not always feel the same; pain intensity depends on prior stimulation. Certain types of repeated stimulation reduce felt intensity while other types increase it (see Hollins et al. 2011; Jepma et al. 2014). Second, pain intensity is influenced by beliefs, emotions, moods, and other mental states and modes. The phenomena of placebo analgesia (pain relief due to positive treatment expectations) and nocebo hyperalgesia (pain increase due to negative expectations) suggest that cognitive mechanisms play an important role in pain experience: expecting pain relief can itself reduce the intensity of pain (Medoff and Colloca 2015; Wiech 2016; see also Wager et al. 2004) while expecting more pain can amplify it (Blasini et al. 2017). Although the experimental investigation of the influence of emotion is more challenging, hypnosis studies suggest that negative emotions can similarly produce increases in pain intensity (Rainville et al. 2005).

Together, these findings cast serious doubt on the notion that the function of the pain system is to inform us about bodily disturbances and their mind-independent features (for a more detailed argument along these lines, see Rosenqvist 2024; see also Coninx 2020; Casser 2021). We do not find a straightforward mapping between pain experiences and physical disturbances, and the idea that pain systematically misrepresents those disturbances is no more attractive than the idea that color experiences systematically misrepresent SSRs (cf. Hill 2009, ch. 6). Although pain systems *can* malfunction—and arguably often *do*, such as in many cases of chronic pain—acute pain serves an adaptive function, even if it doesn't track physical disturbances and their features.

Once we drop the expectation of a straightforward mapping, we can begin to investigate pain experience in a genuinely empirically guided manner. I argue elsewhere that empirical evidence from pain science supports the view that the pain system functions more like a *complex security system* than a simple physical disturbance detector, as the standard model suggests (Rosenqvist 2024; see also Moseley and Butler 2015). For example, the finding that presenting a person with a red light before administering a noxious stimulus heightens the perceived intensity of that stimulus (Wiercioch-Kuzianik and Babel 2019) can be explained by the plausible assumption that people associate the color red with danger. Placebo analgesia, nocebo hyperalgesia, and the influence of emotion on pain are likewise easily explained within the security system view; negative emotions and expectations of intense pain serve as evidence of threat (which leads to

increases in pain intensity), whereas positive emotions and expectations of relief provide evidence of safety (which leads to decreases in pain intensity).

Surprisingly few proponents of non-standard accounts of color perception have proposed similar accounts of pain perception; Matthen (2005, 2015) is an exception. In the next section, I explore possible reasons why some philosophers have favored treating pain and color differently.

6. Is pain experience perceptual?

Many philosophers consider both color and pain experiences to be species of perceptual experience, often because they share certain key features: both are typically localized and particularized, and both are associated with distinctive phenomenology (Hill 2009, ch. 6). At the same time, there are clear differences between them. Pain experience tends to be more directly action-guiding than color experience, while color experience (along with other paradigmatic perceptual experiences) is typically more detailed and informative than pain experience (Klein 2015). These differences may lead some to conclude that pain experience should not be classified as perceptual. An additional point of contrast can be found in concept application: we tend to apply color concepts to external objects (the objects of experience), whereas we apply pain concepts to our experiences themselves. Aydede (2019b, sec. 4.2) takes this to suggest that pain experience is not genuinely perceptual.⁸

If pain experience is not perceptual, then it falls outside the scope of what the standard model of perception needs to explain, and what I have said about pain does not bear on debates about perception. That said, it is important to recognize that objections to treating pain experience as perceptual themselves tend to be shaped by the assumption that the function of perceptual systems is to inform us about mind-independent aspects of the world. If we adopt the agent-centered model, this assumption is dropped, and the objections lose their force. And, indeed, I have argued that the highly variable relationship between *both* color and pain experiences and the properties or states they supposedly track justifies the conclusion that *neither* represents or presents us with those states or properties.

The agent-centered model can treat both color and pain experience as perceptual and therefore accommodate the similarities between them. At the same time, the model can also accommodate their differences because it allows that different types of perception guide successful action in different ways. As suggested earlier, color perception often facilitates action indirectly, by supporting important perceptual and cognitive tasks such as scene segmentation and object/property identification. Pain perception, by contrast, seems to more directly prompt behavioral responses (Rosenqvist 2024). And if color experience is more intimately tied to object perception than pain experience, this may help explain the difference in concept application.

⁸ Aydede proposes the following condition on genuine perception: “an experience kind is genuinely perceptual only if it generally gives rise to proprietary concept applications whose semantic focus is the proper object of this kind of experience” (2019b, sec. 4.2). He argues that we generally do not apply the concept of pain to disturbed bodily states, since we do not take pain attributions to be mistaken when no such bodily disturbance is present. Therefore, pain experience is not genuinely perceptual.

7. Is the agent-centered model trivial?

Another worry is that the agent-centered model doesn't actually answer the question about the function of perception, or that it answers it in a trivial way. Even the standard model acknowledges that perception ultimately serves successful action in an environment, but it gives an account of how it does this, i.e., by (re)presenting aspects of mind-independent reality. The agent-centered model is silent on this question and only makes a negative claim: perceptions need not align with mind-independent reality to play their action-guiding role.⁹

But the agent-centered model is more than a mere rejection of the standard model. As a framework for theorizing about perception, it advocates two methodological guidelines: that we should avoid unwarranted *a priori* assumptions about the specific functions of perceptual systems and that inquiry into those functions should be empirically guided, with attention paid to the ecological needs of the animal in question. As already noted, the model is compatible with the possibility that different types of perception guide action in different ways, some of which may involve tracking mind-independent features. The point is not to rule this out, but to resist assuming it from the outset. The model is therefore *deliberately* non-committal about how perception guides action, in order to preserve the appropriate sort of explanatory openness.

Of course, philosophers sympathetic to the agent-centered approach might conclude that perception *never* aims to track mind-independent properties. I have already mentioned Hatfield's (2016) view that visual perception guides action via subjectively conditioned appearances. If this view, or another view in its vicinity, is extended across all perceptual modalities, no room is left for standard accounts. Such a view may well offer the best account of perception, but the agent-centered model itself is open-ended. In light of the diversity and complexity of perceptual systems, this open-endedness should not be seen as a retreat into triviality, but as a commitment to philosophical rigor and empirical responsibility. There is still much we do not know about perception, and both standard and non-standard accounts have a legitimate claim to theoretical relevance.

8. Ineliminably subjective aspects of perception?

In motivating the agent-centered model, I have suggested that genuine explanation of many perfectly ordinary color and pain phenomena requires appeal to internal features of the perceiver. Even in cases of successful perception, color and pain experiences might not be fully explainable without invoking what Hatfield (2016) calls *ineliminably subjective aspects of perception*. But the notion faces resistance. Critics argue that views appealing to subjective aspects may (i) fail to accommodate the phenomenal character of perceptual experience, (ii) be explanatorily redundant, or (iii) render theories non-naturalistic, contrary to common sense, or both.

First, such views are often thought to conflict with the observation that the qualities we are aware of in perceptual experience present themselves as features of extra-mental objects, not as features of experience itself (Tye 2000, 46; see also Harman 1990, 39). In the case of color and pain, this

⁹ Many thanks to Kari Theurer for raising a version of this objection.

means that we experience colors as properties of objects and pains as properties of our own bodies. Although this may not accurately capture the phenomenology of *all* color and pain experiences, let us grant for the sake of argument that it does. Even so, it is unclear why this should undermine the plausibility of ineliminably subjective aspects of perception. Many philosophical accounts that posit, for example, mind-dependent colors or subjectively conditioned color appearances treat them as relational properties *of object surfaces* or as ways in which *objects appear*. Both of these positions seem capable of accounting for the alleged phenomenology (see, e.g., Hatfield 2007, 149, 158). To challenge such views on phenomenological grounds would require defending the much stronger claim that we experience perceptual qualities *as* mind-independent. But this claim is much more controversial and not clearly supported by the phenomenology of perceptual experience.

The second worry is inspired by Schellenberg and Green (2017). Focusing on spatial perception, they suggest that changes in how objects appear to us correspond to changes in mind-independent relational properties and that spatial appearances are best explained in terms of our awareness of such properties. But the challenge here is to specify what the relevant mind-independent relational properties are and how they explain how things appear to us. Leaving spatial perception aside, I will focus on color (it is unclear what such mind-independent relational properties would even amount to in the case of pain). In section 3.2, I argued that Genone's attempt to account for chromatic appearances in terms of relational, mind-independent properties specified by the intrinsic properties of object surfaces and the spectral properties of the incident light fails because such properties do not correlate well with color appearances. And while incorporating chromatic contexts into the relational properties improves the correlation with color experiences, these revised properties fall short of genuinely explaining phenomena like simultaneous color contrast. If I am right about this, then invoking ineliminably subjective aspects of perception is not explanatorily redundant, but is needed to adequately explain color appearances.

Finally, the standard model prides itself on being closely aligned with common sense (see Crane and French 2021). It is also often motivated by the desire to provide a naturalistic, scientifically respectable account of perceptual phenomenology in terms of mind-independent properties and some relation (causal, informational, direct sensory etc.) that exists between those properties and the relevant perceptual states of the perceiver. Views that invoke ineliminably subjective aspects of perception might then be taken to conflict with these desiderata. But it is not clear how much weight we should place on common sense in philosophical theorizing about perception; after all, common sense tends to overlook the subtle issues that philosophers of perception normally wrestle with. It is also not obvious that some of the more complex representationalist or relationalist views are better aligned with common sense than views that invoke ineliminably subjective aspects. Moreover, it is not obvious why invoking subjective aspects should render a theory less naturalistic, especially if such appeals are grounded in empirical research in perceptual *science* (see Hatfield 2007, 160-161).

To be clear, I am not suggesting that considerations of phenomenology, common sense or naturalism are irrelevant when we evaluate philosophical views of perception, only that such considerations do not obviously favor standard accounts. They also do not outweigh considerations of explanatory power and depth, which I have suggested might be on the side of non-standard accounts, at least in some cases.

9. Conclusion: the agent-centered model as a general model of perception

Color and pain are difficult to accommodate within the standard model of perception. The standard model presupposes that perception aims at (re)presenting aspects of a mind-independent reality, but a careful investigation of color and pain perception suggests that this assumption is unwarranted. In both cases, the relationship between perceptual experiences and the relevant physical properties or states is highly variable, context-sensitive, and plausibly mediated by subjective factors. This undermines a key motivation for the standard model, i.e., the idea that perceptual states reliably correlate with the relevant mind-independent features of the world. While similar concerns might well arise for other types of perception, color and pain stand out as particularly salient examples.

Although color and pain can be accommodated within the standard model by positing widespread misperception or accepting other theoretical costs, I have suggested that the challenges they pose are better seen as reasons to reject the model. In its place, I have offered the agent-centered model which drops the assumption that perceptual states intrinsically track features of mind-independent reality. While I have motivated the agent-centered model by gesturing at the relative strengths of non-standard accounts of color and pain perception, the model itself does not privilege any specific philosophical views; it merely levels the playing field. In endorsing the model, I advocate for an empirically guided, piecemeal approach to investigating different types of perception, and for evaluating competing theories in terms of the scope and quality of their explanations of relevant perceptual phenomena. It is precisely because the model says very little about how perception works, while simultaneously highlighting the widely accepted claim that perception is intimately tied to successful action, that it is well-suited to serve as a general framework for philosophy of perception and as a backdrop for such evaluations.¹⁰

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